THE STRUCTURE OF AMINO-AMIDE FORMALDEHYDE RESINS

BY

FRED EASTERDAY BOETTNER

A.B., Carthage College, 1940
M.S., Tulane University, 1942

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY
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ACKNOWLEDGMENT

The writer wishes to express his appreciation to Professor Carl S. Marvel for suggesting this problem and for his aid and counsel during the writer's graduate study. The author is also indebted to Professor L. F. Audrieth for his many helpful suggestions throughout this investigation and to Dr. Foil A. Miller and Mrs. J. L. Johnson for their help in the infrared spectra studies.

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INTRODUCTION

Elliott[1] has postulated that urea reacts with formaldehyde as an amino acid amide and has carried out some experimental work to substantiate this theory. This thesis represents a continuation of this experimental work and an extension of Elliott's theory to cover the resins formed by the reaction of amino sulfonamides with formaldehyde.

When amino acid amides or amino sulfonamides react with formaldehyde to form polymers, the polymers are probably composed to trimethylenetriamine rings formed by the reaction of the amine groups with formaldehyde. These rings are then linked in a three dimensional structure by methylene bridges between amide or sulfonamide groups attached to the different rings.

DISCUSSION OF RESULTS

The idea that urea reacts with formaldehyde as an amino acid amide has been substantiated by the formation of polymers by the reaction of true amino acid amides with formaldehyde. *Epsilon*-aminocaproamide, prepared by the method suggested by Elliott[1], gave a cross-linked polymer which closely approximated 1.5 methylene units per amino acid amide residue. Sarcosinamide has been shown to form a low molecular weight linear polymer with formaldehyde.

A mechanism for the polymerization of sulfamide-formaldehyde resins, based on the view that sulfamide is an amino sulfonamide, has been suggested. The polymerization is postulated as proceeding in two stages: first, the formation of trimethylenetriamine rings from methylene sulfamide or the monomeric methylene methylol sulfamide, and then, the

formation of methylene-*bis*-amide links to tie the rings together to form a cross-linked molecule.

As support for this theory resins have been prepared from the reaction of taurinamide and 6-aminohexanesulfonamide with formaldehyde. These amino sulfonamides were prepared by the method of Christiansen[2]. The composition of these resins indicate that they are composed of trimethylenetriamine rings linked by methylene bridges between sulfonamide groups on different rings.

The reaction of N-substituted urethans with ammonia has been studied and a mechanism for this reaction has been suggested. The reaction of mono- substituted urethans is postulated to proceed through the intermediate formation of isocyanates. As support for this theory it has been shown that N-methylurethan reacts with ammonia to yield monomethylurea. Methylisocyanate also reacts with ammonia to give monomethylurea[3].

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VITA

The author was born in Murphysboro, Illinois, on December 10, 1918. He attended the public schools of Murphysboro, Illinois, and graduated from Murphysboro Township High School in June, 1936. He attended Carthage College in Carthage, Illinois, for four years where he received the degree of Bachelor of Arts with a major in Chemistry in June, 1940. He entered the Graduate School of Tulane University of Louisiana in New Orleans in the fall of 1940. He held a teaching assistantship in Organic Chemistry while he attended Tulane University. He received the degree of Master of Science in Organic Chemistry from Tulane University in June, 1942. From July, 1942, until March, 1943, he was employed as a research chemist by the Monsanto Chemical Company at Anniston, Alabama. He was employed as a research chemist by Higgins Industries Incorporated in New Orleans, Louisiana, from March, 1943, to December, 1943. From December, 1943, to October, 1944, he was employed as an Associate Organic Chemist by the Armour Research Foundation in Chicago, Illinois. He entered the Graduate School of the University of Illinois in October, 1944, and held teaching assistantships for five semesters and a University of Illinois fellowship the third year.

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